Australian Entomologist, 2000, **27** (1): 1-4

NESTING BIOLOGY OF THE AUSTRALIAN STEM-NESTING WASP *RHOPALUM BENDORENSE* LECLERCQ (HYMENOPTERA: CRABRONIDAE)

Robert W. Matthews

Department of Entomology, The University of Georgia, Athens, Georgia 30602, USA

Abstract

Female *Rhopalum bendorense* Leclercq excavated 1.5-2.5 mm diameter burrows in recently exposed pithy green stems of various shrubs during January to March 1999 in Canberra, ACT. Burrow length averaged 55 mm (range 19 to 105 mm). Prey comprised six families of flies and two families of adult Psocoptera; Diptera predominated 4:1. Females practiced modified mass provisioning; the egg was laid transversely on the prothorax of one of the first several prey, with additional prey provided (up to 41 total) by the time the larva began to feed, at which point the cell was closed with a partition of compact pith. In two of the 14 active nests more than one female was present, but their relative contributions were unknown. No parasitoids were reared and there appeared to be two overlapping generations. Reared sex ratio from the first generation was about 2:1 female biased.

Introduction

Rhopalum Stephens is found world-wide with 109 species listed by Bohart and Menke (1976). Until recently only 32 species were known for Australia, but Leclercq (1997) described 66 new species from Australia, placed into 19 species groups. Surprisingly little has been published on the nesting behaviour of Australian species. Rayment (1932) recorded *R. verutum* Rayment nesting in reeds, often 'renting' cells of a bee and preying on flies. Evans and Matthews (1971) described the biology of a soil nesting species, *R. variitarse* Turner, also a specialist on various flies. Leclercq (1997) noted that Australian species are known to nest in soil, twigs and wood, and reported an unusual prey of a winged ant pinned with a female *R. carnegiacum* Leclercq from New South Wales. Studies of *Rhopalum* species elsewhere (e.g. Krombein 1964, Kislow and Matthews 1977), indicate that members of the genus nest in pre-existing cavities in stems, galls and beetle burrows and prey on flies or Psocoptera.

Rhopalum bendorense Leclercq was described from two specimens, a single female from Bendora, A.C.T. (holotype) and a paratype female from Collinsville, Tasmania (Leclercq 1997). This species is not closely related to any other Australian species and is the sole member of its species group (Leclercq 1997). I present here the first biological data for *R. bendorense*, including description of the nests and prey records.

Methods

Female *R. bendorense* were first encountered on 25 January 1999, when three females were found resting in an unidentified pithy stem in Deakin, a suburb of Canberra, Australian Capital Territory. Subsequently, 22 nests were collected at three A.C.T. sites between January 25 and March 3, 1999. All nests were collected during the day and split lengthwise to reveal their contents. Prey were preserved in 70% ethanol. After nest architecture and cell contents were recorded, nests were individually stored in plastic boxes

and checked daily for emergences. Voucher specimens of wasps and prey have been deposited in the collections of the Australian National Insect Collection, CSIRO, Canberra and the Australian Museum, Sydney.

Results

In all, the 23 nests contained a total of 40 cells. All nests were incomplete, and most were recently initiated, many either being excavated or containing partially provisioned initial cells. One of the nests contained two females and another contained three females. It was apparent that the females actively excavate the soft pith from green stems to form their nests. Recognised nesting plants were honeysuckle (*Lonicera* sp.), hydrangea (*Hydrangea* sp.) and rose (*Rosa* sp.).

Nest burrow diameters ranged from 1.5 to 2.5 mm. Burrow lengths ranged from 19 to 105 mm (average 55 mm). Cell lengths varied, but most ranged between 5 to 12 mm. All nests were in slender green stems 3 to 5 mm in diameter that had been recently pruned, exposing the pith. Partitions between cells appeared to consist of tiny bits of chewed plant pith fibres tightly compacted to 1 to 2 mm thick. The largest nest contained six cells, three recent and three apparently older.

Table 1. Prey taken from 14 nests of *Rhopalum bendorense* in Canberra, ACT.

Order and Family	Species	Number
Diptera		
Drosophilidae	*Drosophila* sp.	6
Chloropidae	sp. 1	3
Chironomidae		
Orthocladiinae	*Procladius squamiger*	2
	prob. *Austrocladius* sp.	6
	sp. 1, not *Austrocladius* sp.	1
Chironominae	prob. *Polypedium* sp.	1
	four additional unidentified spp	7
Ceratopogonidae	*Culicoides* sp.	1
	three unidentified spp.	10
Sciaridae	? *Bradysia* sp.	30
	sp. 1, not *Bradysia* sp.	5
Cecidomyiidae	sp. 1	1
Unidentified Diptera		4
Psocoptera		
Caeciliidae	*Enderleinella* sp.	3 ♂, 3 ♀
Ectopsocidae	*Ectopsocus briggsi* McLachlan	1 ♂
	Ectopsocus punctatus Thornton & Wong	8 ♂, 1 ♀
Unidentified Psocoptera		5

Prey (n = 98) were obtained from 14 nests (Table 1). All belonged to the Diptera (six families represented) or the Psocoptera (two families represented). Diptera were the predominant prey (n = 77), but cells in six

nests contained both flies and psocids. Six nests had flies only and in two nests only psocids were found. Typically, prey were placed head first or were sideways in the burrow and not tightly packed. Prey were profoundly paralysed, only able to twitch a leg if touched.

The egg is laid on the venter of the thorax or between the head and prothorax ('neck') of one of the first few prey items stored. The egg is attached by its cephalic pole and is transverse to the longitudinal axis of the prey item. Some nests contained up to 7 prey with no egg, while others contained only a single prey with an egg attached. Two measured eggs were 1.2 x 0.3 mm and 1.25 x 0.37 mm in size.

The single completely provisioned cell contained 37 flies and 4 psocids, with a newly hatched larva. This cell was not yet closed, but there was a pile of pith particles accumulated adjacent to the last prey, which suggested that cell closure was being initiated. Small feeding larvae were encountered in several other unclosed cells, suggesting delayed mass provisioning. Cocoons were parchment-like and opaque. Bits of prey remains were often incorporated. Eleven female and five males *R. bendorense* were reared from five nests. Progeny in the remaining nests entered diapause and none had emerged by the time the study was terminated in May 1999. No parasitoids were found or reared.

Discussion

The possibility of cooperative nest sharing is suggested by the discovery of two nests with more than one female present. Because nests were collected during the day when adults may have been away from their nests, it is possible that this behaviour is more common than was documented here; it certainly merits further study. Because nests are excavated in pithy stems, cooperation in the early stages of nesting would likely reduce the time required to establish nests. Additionally, cooperation may reduce losses due to parasitoids and predators, although parasitoids that attack after cell closure by oviposition through the stem from the outside would not likely be deterred.

Excavation of nests in plant stems is not universal in stem-nesting *Rhopalum.* Other species appropriate pre-existing cavities, such as those initially made by bees (Rayment 1932, Kislow and Matthews 1977). The absence of any parasitoids reared in this sample is striking, given that other species of stem-nesting wasps studied concurrently were frequently attacked (Matthews, in press).

While the paucity of material in existing collections suggested *R. bendorense* to be relatively rare, this species is actually quite common locally, as Krombein (1964) found for the hibiscus wasp, *R. coarctatum* (Scopoli) [the synonym *Euplilus modestus* Rohwer was used by Krombein]. In my samples of various pithy plant stems, this species was the most frequently encountered. Two species of *Nitela* (Matthews, in press) and one of

Arpactophilus were the only other sphecids found nesting concurrently in the same stems, but these two species were much less common.

It appears that there are at least two generations per year in the Canberra area. However, evidence for this is circumstantial, based on the fact that progeny from nests collected in late January emerged by late February, whereas progeny of the nest collected in early March had entered diapause.

Rhopalum bendorense appears to be an opportunistic predator on a range of lower Diptera and Psocoptera. However, individuals did tend to specialise. For example, all but one of the *?Bradysia* sp. were found in a single cell. Several of the fly prey are swarm-mating species and it seems likely that *R. bendorense* females capture prey from such aggregations. Interestingly, all of the psocid prey were adults and both sexes were evenly represented. According to C. Smithers (pers. comm.) the Ectopsocidae nearly all live in leaf litter or in dead leaves hanging from trees or shrubs, often concealed in curled leaves. Caeciliidae are usually encountered on the undersides of green leaves. Because the flies may be taken from mating aggregations, it seems possible that the psocids were taken in similar circumstances. The *Nitela* nesting concurrently in the same habitat also preyed on psocids, but captured exclusively nymphs belonging to different families which are gregarious bark dwellers. Also, the nymphs were only lightly paralysed, whereas the adult psocids taken by *R. bendorense* were profoundly paralysed.

Acknowledgments

I thank Dr C.N. Smithers (Australian Museum) for identifying the Psocoptera prey and Dr Peter Cranston (CSIRO Entomology) for identifying the Diptera. Financial support from the University of Georgia and a McMaster Fellowship from CSIRO are gratefully acknowledged.

References

BOHART, R.M. and MENKE, A.S. 1976. *Sphecid wasps of the World. A generic revision.* University of California Press, Berkeley; 695 pp.

EVANS, H.E. and MATTHEWS, R.W. 1971. Notes on the prey and nests of some Australian Crabronini (Hymenoptera: Sphecidae). *Journal of the Australian Entomological Society* **10**: 1-4.

KISLOW, C.J. and MATTHEWS, R.W. 1977. Nesting behavior of *Rhopalum atlanticum* Bohart (Hymenoptera: Sphecidae: Crabroninae). *Journal of the Georgia Entomological Society* **12**: 85-59.

KROMBEIN, K.V. 1964. Natural history of Plummers Island, Maryland, XVIII. The hibiscus wasp, an abundant rarity and its associates. *Proceedings of the Biological Society of Washington* **77**: 73-112.

LECLERCQ, J. 1997. Hymenopteres Sphecides Crabroniens d'Australie, du genre *Rhopalum* Stephens, 1829. *Notes fauniques de Gembloux* no. **32**: 3-101.

MATTHEWS, R.W. 2000. A new species of *Nitela* (Hymenoptera: Sphecidae; Larrinae) from Australia with notes on the nests and prey of two species. *Journal of Hymenoptera Research.* **9**: 41-47.

RAYMENT, T. 1932. The flycatcher of the reeds. A new crabronid wasp. *Victorian Naturalist* **48**: 171-174.